AIR CLEANING
NEW DEVELOPMENTS AT U.C. RADIATION LABORATORY

By M. D. Thaxter, UCRL

I'd like to touch on two items under the heading of new developments at the Radiation Laboratory, under the topic of air cleaning. The first is a minor item, a scrubber for the entire or partial removal of corrosive vapors. We've been fiddling with this gadget for 2-1/2 years and have found it useful in our box applications as well as in non-radioactive bench chemistry. Its purpose is to protect filters, ducts, blowers and other air cleaning and air handling equipment. At the outset let me give credit to the Harvard air cleaning lab for the stimulus received there in 1951 where their scrubber was demonstrated. We used the saran bed reported by them. The resemblance ends there, however, and our results cannot be compared with theirs. We were seeking a very compact package whereas Harvard's was on an industrial scale.

We may describe our unit as "a small vertical gas scrubber, concurrent flow, single stage, with saran fiber bed, scrubbing liquor circulated by air lift, and containing an integral reservoir." A downstream exhauster is universally used.

The unit may be said to have two major portions, upper and lower. The upper portion contains gas inlet port, liquor discharge, spreader plate, saran bed disengaging space and gas outlet. The lower contains the air lift feed and reservoir of scrubber liquor. The assembly is tubular and has been made in three sizes, our so-called 2", 4" and 6" sizes. The 2" and 4" sizes are self-contained in polyethylene and industrial glass Pyrex pipe sections respectively, whereas the largest is 6" Pyrex pipe housed in a 30 gallon common drum, polyethylene lined.

Some dimensions may be of interest:

DATA:	Scrubber Size & Dimensions		
	2"	4"	6"
Overall height, inches	17.5	34	34
Width, inches	2	4	21
Bed internal diameter inches	1.8	3-5/16	4-3/4
Bed cross sectional area--inches	2.6	8.3	17.8
Bed depth--inches	6	10	10
Lift height--inches	17	25	26
Liquid resevoir height--inches	8.5	12	16
volume--	---	2 liters	17 gallons
Liquor cycling rate, cc's/min.	---	400	600
Thruput gas volume as lift air	---	0.23 CFM	1.7 CFM
Total gas thruput @ 3" w.g., CFM	3-1/4	10	19.2

It was experimentally determined by cut and try methods that the optimum air line tube diameter was 7 mm inside the air lift tube of 16 mm.

Observe in the above data the thruput is directly related to bed diameter. Laboratory efficiency tests have been run only on the 4" size with and without an upstream condenser. Vapors from boiling 12.6 M HCl mixed at the vapor pickup with room air to make up volume was the feed material. Hence the concentration dropped as volume went up. Total acid in each run was 100 ml boiled to dryness. The tests were repeated with 16.2 M HNO_3. Efficiency calculations are based on back titration of scrubber liquor which was 2 N NaOH. Results are expressed as % removal to scrubber liquor from the air stream.

HCL tests

CFM	4" scrubber	4" scrubber with condenser
5	66	100
3	71	91
1	88	--

HNO_3 tests

CFM	4" scrubber	4" scrubber with condenser
5	58	--
3	--*	67
1	--*	98

*Not determined; acid reacted with tubing used in assembly.

In one application where beta-gamma radioactive mists were encountered the scrubber also acted as a satisfactory air cleaner. This is, however, an exception; its efficiency for particulates is like all scrubbers, rather poor. Qualitatively these scrubbers have performed well for our major purpose of protecting downstream equipment. They have worked visibly well on HF as expected but not so well on H_2SO_4. The 4" and 6" units are mounted downstream and outside of Berkeley boxes. The 2" under current study is designed to go inside such boxes. Rough sketches are available for those interested.

The second item to be discussed is more important. It might be said that it concerns not air cleaning, but a method of avoiding a probable failure of air cleaning. A few introductory remarks are necessary: At UCRL we encounter our major air cleaning problems in connection with investigations on the transuranics. Substantially, as you know, these are alpha emitters; some of them are beta-gamma and neutron emitters as well. When the specific activity is high a very small percentage loss to room air or to stack gas will result in exceeding the AEC limits for air pollution.

When one manipulates substantial quantities of high specific activity material and the treatments involve heating, cooling, stirring, transferring, gassing, centrifugation, precipitation, dissolving, evaporation to dryness and a host of energetic chemical reactions, the chances for aerosol formation and dispersion are considerably enhanced.

Since in research practice it never occurs that the sequence of processing events, or conditions surrounding each event, is duplicated in successive experi-

"sausage link" prepared by the usual heat-sealing technic. All components of the system are liquid, solid and gaseous waste receivers as such, and will be concrete jacketted and buried at the termination of the operations, with the exception of the accumulator tanks. It is planned to sample the bags in these and assay their contents by three methods: filtration, ESP and vibrating reed electrometer. Attempts to clean the accumulated gases are planned and will be prosecuted if time and the assays permit. In the event of poor success the gases will be compressed in steel cylinders, jacketted in polyethylene and encased in concrete for burial.

We have become truly amazed at the detailing required. The two operating boxes require eleven gloved boxes to serve them, 1200 feet of polyethylene pipe, 500 hose clamps, over 150 valves and much other impedimenta. The cost is of course commensurate. The designed capacity of the system is 615 cubic feet with a two-fold safety factor on volume. It is anticipated the equipment will run continuously for some 60 days. An example of the complexity a closed system requires may be given. Consider the sole factor of environmental temperature variations. We plan to hold the system at all times at about minus 1/2" water gauge with respect to atmospheric pressure. Yet a shift of 11 degrees F would cause a change of pressure in all voids of the apparatus of about 13" w.g. Stated another way, if the volume of one of our accumulators is 240 cubic feet, this would mean a volume change of about 8 cubic feet just because of this small temperature variation. This must be allowed for in the sensing and controlling apparatus and provisions made for tempering the ambient atmosphere.

What I should like to hear at this meeting of course is a description of an air cleaning train with sufficiently ample decontamination ability so all the above headaches could be avoided when we run into this type of problem again.